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PREVENTIVE GEOTECHNICAL ENGINEERING AND ITS APPLICATION TO THE LINGAN-PHALEN AND DONKIN-MORIEN DEVELOPMENT PROJECTS: A DISCUSSION PAPER

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by

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ABSTRACT

The need for the application of the concepts of preventive geotechnical engineering to major mine developments is emphasized. An approach suitable for adoption at the Donkin-Morien and Lingan-Phalen development projects is described, based on the development of a trial retreat system.

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DISCUSSION DU GÉNIE GÉOTECHNIQUE PRÉVENTIF ET DE SES APPLICATIONS POUR LES PROJETS DE MISE EN VALEUR LINGAN-PHALEN ET DONKIN-MORIEN

par

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RÉSUMÉ

Le rapport souligne la nécessité d'appliquer les notions du génie géotechnique préventif aux projets de mise en valeur minière de grande envergure. L'auteur décrit une méthode appropriée pour les projets de mise en valeur Donkin-Morien et Lingan-Phalen, laquelle est fondée sur la mise au point d'une méthode d'exploitation en rabattant.

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INTRODUCTION

The Donkin-Morien development project is intended to provide the Cape Breton Development Corporation with an estimated 3.6 MTPY of saleable thermal and metallurgical coal. Production is expected to start in 1987, reaching full capacity in 1990 and continuing for a period in excess of fifty years. The location of the reserve block and the intended extraction of several seams necessitates total extraction of the coal on a retreat system utilizing dual life gateroads. Failure of this mining system under these conditions would be expected to dramatically reduce production rates, percentage extraction and productivity, thus, substantially altering the economic viability of a project estimated to cost between $500 - $1,000 million.

The crucial importance of the project to CBDC and to the industrial area is reflected in the amount of predevelopment drilling, the research undertaken concerning the stability of the access declines and the ventilation studies conducted on the tunnel boring machine currently being commissioned. Although many other factors are of vital importance to the project, perhaps the most fundamental of these is the viability of the mining method itself. Upon this is based the notion of total extraction in multiple seams, productivity gains over conventional methods and the whole of production planning aimed at recouping development costs. In these circumstances it would be unthinkable not to be concerned with the design and implementation of the proposed mining system.

Similarly the Lingan-Phalen development project proposes total extraction retreat longwall mining with dual life gateroads.

In the United Kingdom the method of longwall retreat mining with dual life gateroads has been shown to be effective only where effective criteria for determining the correct design of the roadway support system have been present. In both recorded failures of the method design cirteria were either absent or inapplicable. Such success as has been achieved is due directly to the application of preventive geotechnical engineering concepts.

PREVENTIVE GEOTECHNICAL ENGINEERS

In a recent paper Neff (1) described the concept of preventive geotechnical engineering in civil engineering mega-projects, and stated that:

> 'Civil engineers have historically emphasized problem solution rather than prevention. Logic and prudence suggest that a formal approach to problem prevention (in all phases of facility life) can provide efficient and cost effective techniques to enhance or improve performance. The need for such a concept remains somewhat obvious when one considers the type and number of failures noted in the literature.'

These comments apply equally well to mining engineers in general and to the mining method proposed at the Donkin-Morien and Lingan-Phalen development projects. A prudent approach to fulfilling professional responsibilities would encourage efforts to reduce the chances of failure at some reasonable cost. Experience with preventive geotechnical engineering at other localities has shown promising results and in many cases a high degree of cost effectiveness.

The approach suggested below involves the development of a trial retreat section using dual life gateroads in the coalfield, combined with an extensive geotechnical investigation to develop design criteria for use at the Donkin-Morien and Lingan-Phalen development projects.

PROPOSAL

In order to ensure the success of the mining method proposed for implementation at the Donkin-Morien and Lingan-Phalen development projects, it is essential to provide site specific design criteria for the gateroad support system. The basis of this proposal is the development of a retreat longwall section at an operating colliery combined with preventive geotechnical

engineering. The development of the retreat section and the form of the preventive geotechnical engineering programme are outlined below.

DEVELOPMENT OF THE RETREAT SYSTEM

The successful application of dual life gateroads serving retreat faces in the U.K. was founded on the results of geotechnical investigations conducted at a full scale trial site. The same approach should be adopted here.

Several locations for the trial could be considered, although care must be taken to review other factors likely to influence the success or failure of the trial; for instance, transport facilities to maintain the development required, ventilation capacity and the impact of the trial on CBDC operations and development plans.

Major advantages of adopting the development of a trial retreat section, rather than waiting to conduct design trials at Donkin-Morien or Lingan-Phalen would be the development of a workable retreat system at the trial mine with consequent productivity benefits, the development of local expertise in the mining method, the elimination of commissioning problems with novel equipment and the development of confidence in the mining method as well as the stated aim of providing design criteria for the Donkin-Morien and Lingan-Phalen applications.

If the method of adopting a trial system is not used, the concepts of preventive geotechnical engineering must be applied from the start at Lingan-Phalen and Donkin-Morien. Low initial success should be accepted as well as the need for a major geotechnical effort involving cored borehole drilling, instrumentation and monitoring. In addition, flexibility should be maintained in the support system to allow major changes in response to unanticipated mining conditions.

PREVENTIVE GEOTECHNICAL ENGINEERING PROGRAMME

The programme proposed is directed entirely at the problem of providing design criteria for dual life gateroads, although the basic structure used here could be applied to any similar project. The programme

structure proposed to determine optimum support design in dual life gateroads is as follows:

A. Statement of Expected Performance
The designer/owner/operator should jointly prepare a clear statement of the expected performance of the gateroads, e.g. life expectancy, allowable convergence. This should include performance at all stages in the roadway life.

B. Review of Similar Projects
The risks, failures, remedial tasks and costs associated with previous similar projects should be reviewed and evaluated.

C. Formal Summary Document
This document should include detailed analysis of the following:
- major uncertainties in design,
- key assumptions in design,
- key parameters that control performance,
- critical values of key parameters,
- possible consequences of adverse performance and operation,
- method(s) to obtain values of key parameters,
- method(s) to evaluate the portray performance data, and
- decision making plans and alternative courses of action.

D. Form Geotechnical Task Force
Including staff from owners, designers, etc., this task force will seek to reach or exceed the stated performance criteria at a minimum cost.

E. Continuing Evaluation Plan
After the implementation of the trial, a continuing evaluation of performance and costs should be maintained to fine tune and respond to major changes in mining conditions.

It is expected that much of the information gathered during the recently proposed gob leakage investigation (2) (i.e. performance of existing pack systems and review of alternatives) will be of direct benefit to the preventive geotechnical engineering programme.

SUMMARY

This document proposes a trial retreat mining section with dual life gateroads in an existing colliery with support in the form of a preventive geotechnical engineering programme. It is considered that such a process would provide valuable design criteria, background information and local experience with dual life gateroads in retreat longwall mining and thereby simplify the implementation of that mining method at Lingan-Phalen and Donkin-Morien.

It is believed that such a trial should be undertaken at either Lingan or Number 26 Colliery. Such a trial would conincidentally provide the opportunity to convert from advance to retreat longwall mining.

REFERENCES

1. Neff, T. L., "Preventive Geotechnical Engineering - Pay Now or Pay Later"; Speculations in Science and Technology, V5, No. 3, 1982.